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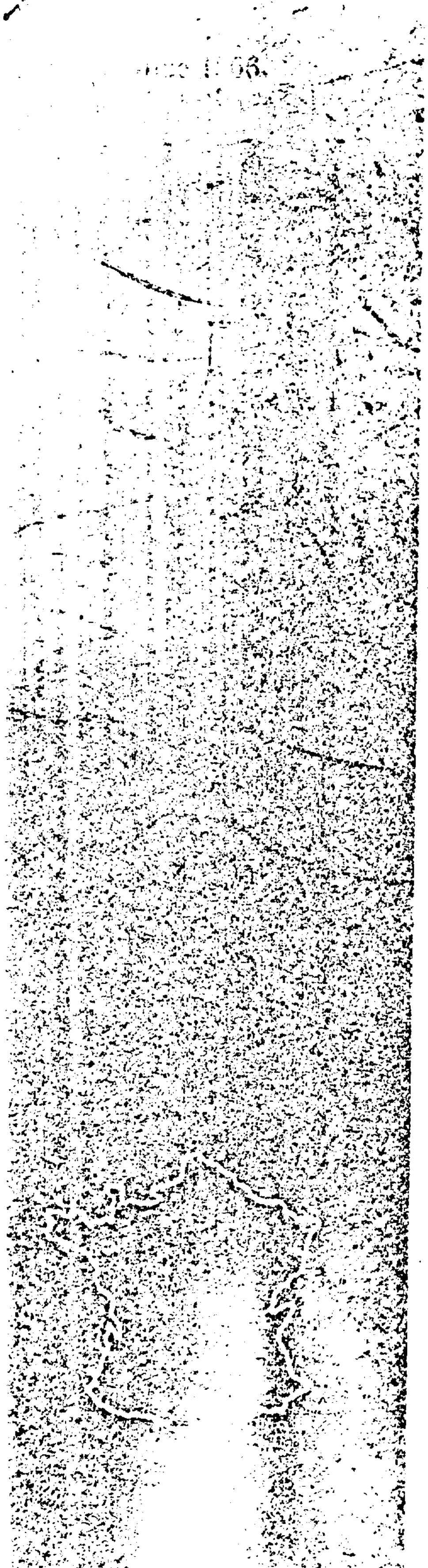

The French Nuclear Tests In the Pacific

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WHY EXPERIMENTAL NUCLEAR EXPLOSIONS?

The total number of atmospheric explosions carried out to date by the countries building nuclear arsenals is:

195 for the United States,
141 for the USSR,
21 for Great Britain,
4 for France,
3 for China.

France has had to note that the partial disarmament measures taken or contemplated—such as the signature of the Moscow Treaty—far from limiting the power of the countries equipped with the greatest means of destruction, have actually solidified their lead.

France has always considered disarmament a basic goal which deserves her greatest efforts. But, when conditions of a nuclear threat continue to weigh on the world, France must take steps to free herself of that threat. The tests she is conducting are merely one link in her defense program, and an essential one in view of its state of advancement.

The construction of a French deterrent force, which obviously has received Parliamentary approval, is in no way designed to serve aggressive or expansionist purposes.

All precautions have been taken so that the French tests will in no way affect the health of the populations close to or far from the test sites and will disturb their normal activities as little as possible. Compared to the measures taken during the hundreds of tests conducted by other countries, which have not significantly raised the level of radiation in man's environment, these precautions appear especially strict.

THE MAJOR DECISIONS
THAT LED TO THE FRENCH NUCLEAR TESTS

The creation of the French Atomic Energy Commissariat by General de Gaulle's ordinance of October 8, 1945 was the first step in the process that was to lead France to the rank of a nuclear power. Subsequently several Governments of the Fourth Republic, recognizing the importance of equipping France with atomic weapons, took some major steps in that direction—in particular, the decision adopted in principle at the beginning of 1958 by the President of the Council of Ministers, Félix Gaillard, to build and test a plutonium bomb in 1960.

On July 22,1958 a decision was made to set the first quarter of 1960 as the date for France's first nuclear test explosion. The explosion actually took place on February 13, 1960 at Reggane in the Sahara. Two consecutive military appropriations bills, for 1960-64 and 1965-70, were adopted by Parliament and enabled France to build the nuclear weapons needed to equip her deterrent force.

The first generation of those nuclear weapons is operational and consists of fission bombs carried by the Mirage IV, a supersonic bomber (Mach 2.2). These weapons are derived from the experimental atmospheric devices fired in 1960 and 1961 at Reggane in the Sahara.

The second generation of the weapons, contained in the second appropriations bill, is a ballistic missile: it is designed for the French nuclear submarines and will be armed with a nuclear warhead.

Between these two generations, a medium-yield weapon is planned to maintain the French deterrent force at a level sufficient to insure the country's security between the time when the deterrent capability of the Mirage IV aircraft may be reduced and that when the nuclear submarine becomes operational.

France's first program of atmospheric atomic tests was completed on April 25, 1961. Since that date, underground tests exclusively have been conducted at In-Ecker in the Hoggar region of the Sahara. Through these tests has been gathered the information necessary for continuing the French nuclear weapons program.

The intermediate weapons and the second-generation weapon now remain to be built. The corresponding studies are very advanced and have to be checked out by testing. The only suitable place for this testing is the vast maritime expanses of French Polynesia. There, the populated islands are so dispersed and the meteorological conditions are such that nuclear test explosions can be conducted under security conditions satisfactory for both the testers and the populations

That is why the French Government decided in 1962 to set up the Pacific [illegible]

DEFINITION OF THE SECURITY STANDARDS FOR NUCLEAR TESTING

Man's environment has always contained natural radioactive substances. They emit rays spontaneously, and man has no control over them. However, these natural substances have steadily become less active, and man is now subject to a much lower level of natural radiation than when he first appeared on earth.

Natural radioactivity has not prevented man from evolving to his present state.

The discovery of natural radioactivity dates back only three quarters of a century. As man furthered his knowledge, it became possible for him to change the make-up of atomic nuclei by bombarding them with elementary particles, thereby creating artificial radioactive elements. These elements emit the same rays as natural radioactive elements and also become less active with time. Some of the peaceful purposes that man has discovered for these rays are the use of radioisotopes in medicine, agronomy and industry and, most importantly, the conversion of atomic energy into electrical energy.

But since the first atomic bomb was detonated in Hiroshima, the possibility of using radioactivity for a destructive purpose—through nuclear fission or fusion—has become a fact: five countries have conducted experimental nuclear explosions in the atmosphere in order to build nuclear weapons. For 20 years, man has therefore been exposed to the resultant radioactive fallout all over the earth's surface.

Handling atomic energy, whether at nuclear installations or during weapons tests, entails a risk that must be fully known and assessed.

There is now sufficient knowledge of that risk to take the precautions essential in order to safeguard people and protect property when conducting nuclear tests.

In particular, the site for the explosion should be chosen in sparsely populated parts of the globe. Comparison of weapons test sites shows that the French nuclear firing grounds, at Reggane in the Sahara yesterday and in French Polynesia today, fully meet this condition.

The Lessons Learned From the Nuclear Tests

The nuclear weapon has some destructive effects that are similar to those of aircraft bombs or artillery shells armed with chemical explosives, such as blast and heat effects. But it also gives off a nuclear ray that is initially destructive although limited in time.

Immediate Effects

An experimental nuclear explosion, like all nuclear explosions, produces immediate effects that are limited in space or time.

The inhabitants of the Japanese cities of Hiroshima and Nagasaki experienced direct effects from atomic bombs. Using the observations made in those two cities, the extent of the area exposed to the effects of the nuclear explosion has been pinpointed. It has been found that no inhabitant of Hiroshima living more than 1.8 miles from the point of explosion was exposed to the immediate effects of the bomb.

Delayed Effects

Nuclear tests also produce radioactive fallout, which is usually divided into local, distant and global fallout that is spread over a long period of time.

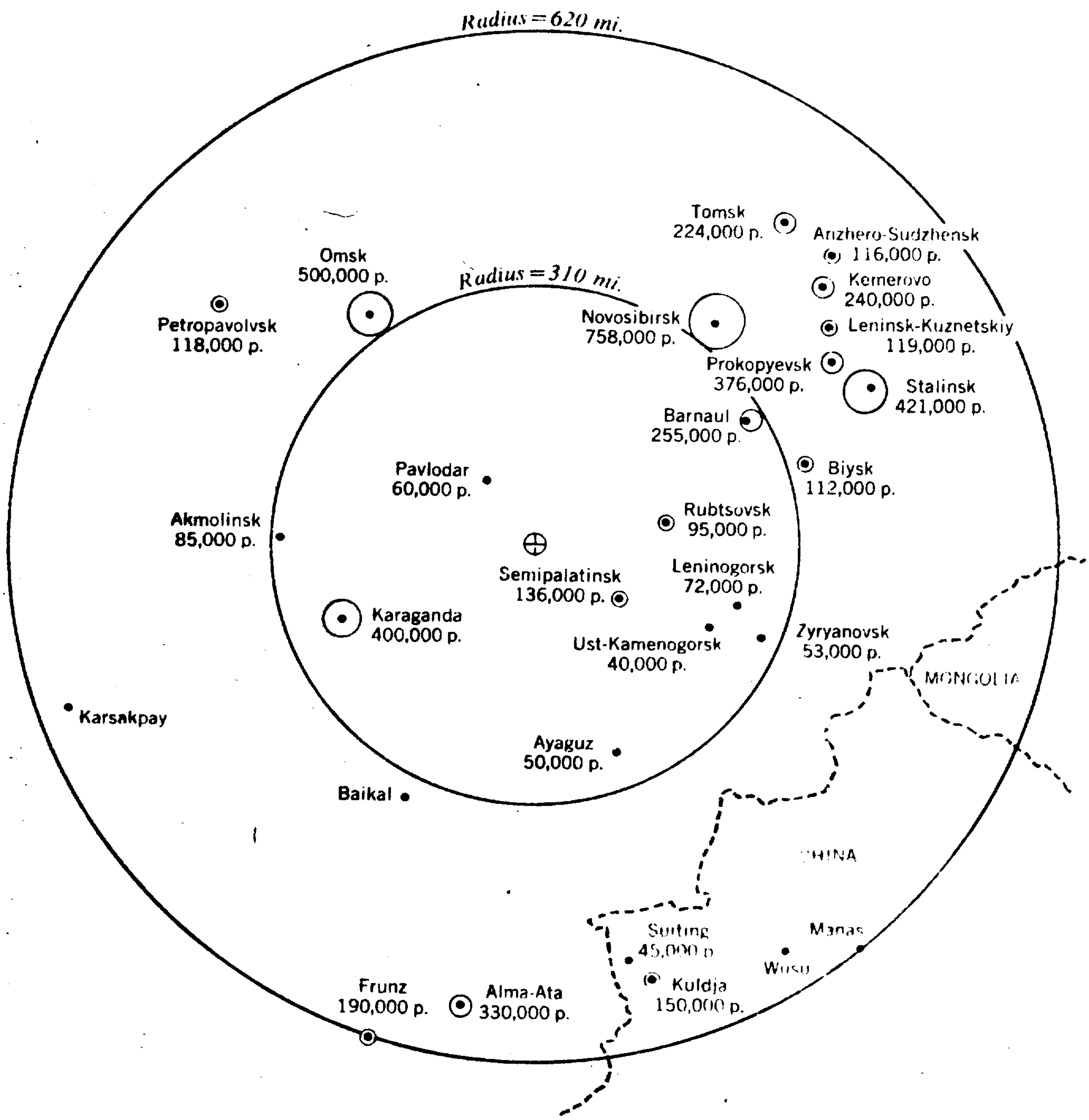
Local fallout is made up of activated heavy debris and fragments of earth torn from the soil at the time of the explosion that fall back by the force of gravity. These materials reach the earth's surface in a few hours and scatter over a distance that varies with the explosion's yield. They can drift from 60 to 250 miles with the direction of the wind and about 30 miles perpendicular to the wind. They contain a high proportion of short-lived radioactive products.

Distant fallout is composed of finer particles projected into the lower layers of the atmosphere—up to 7 miles on the average or in the troposphere—and is carried around the earth by the prevailing winds. These fine particles fall slowly, often dropping to the surface in atmospheric precipitation, and scatter in a wide latitudinal band centered approximately on the proving grounds.

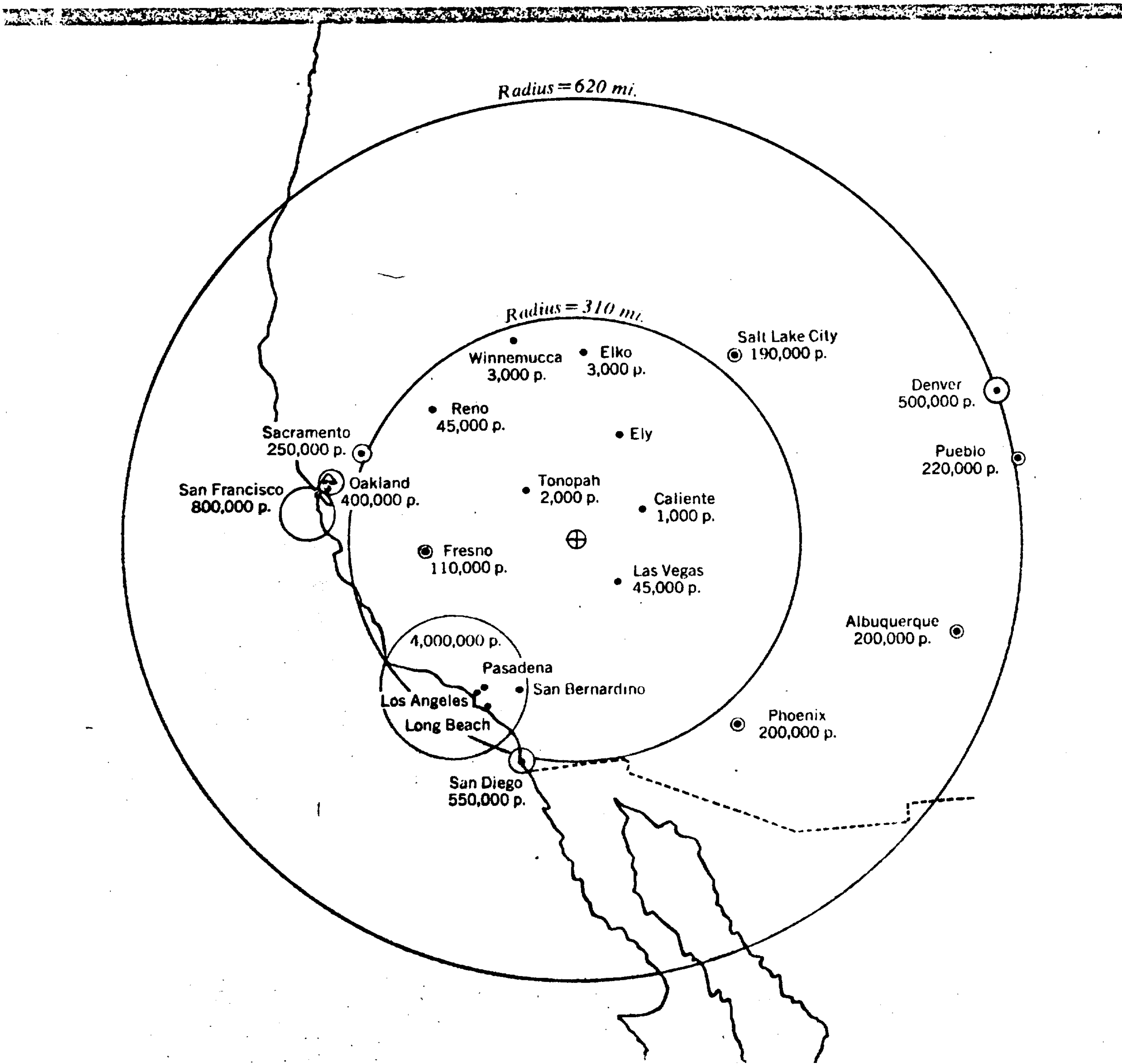
Global fallout comes from very fine particles carried into the stratosphere (above 7 miles) on which gravity has a very slight effect. These particles, exposed to the movements of stratospheric winds, have great difficulty crossing back through the tropopause—a layer between the stratosphere and the troposphere—and take several years to fall to the earth's surface. By that time, the short-lived products that these particles contain have all disappeared, and the level of radioactivity due to the remaining products is insignificant.

Local fallout alone is therefore dangerous.
It affects only the testers and the zone located in immediate proximity to the firing grounds.

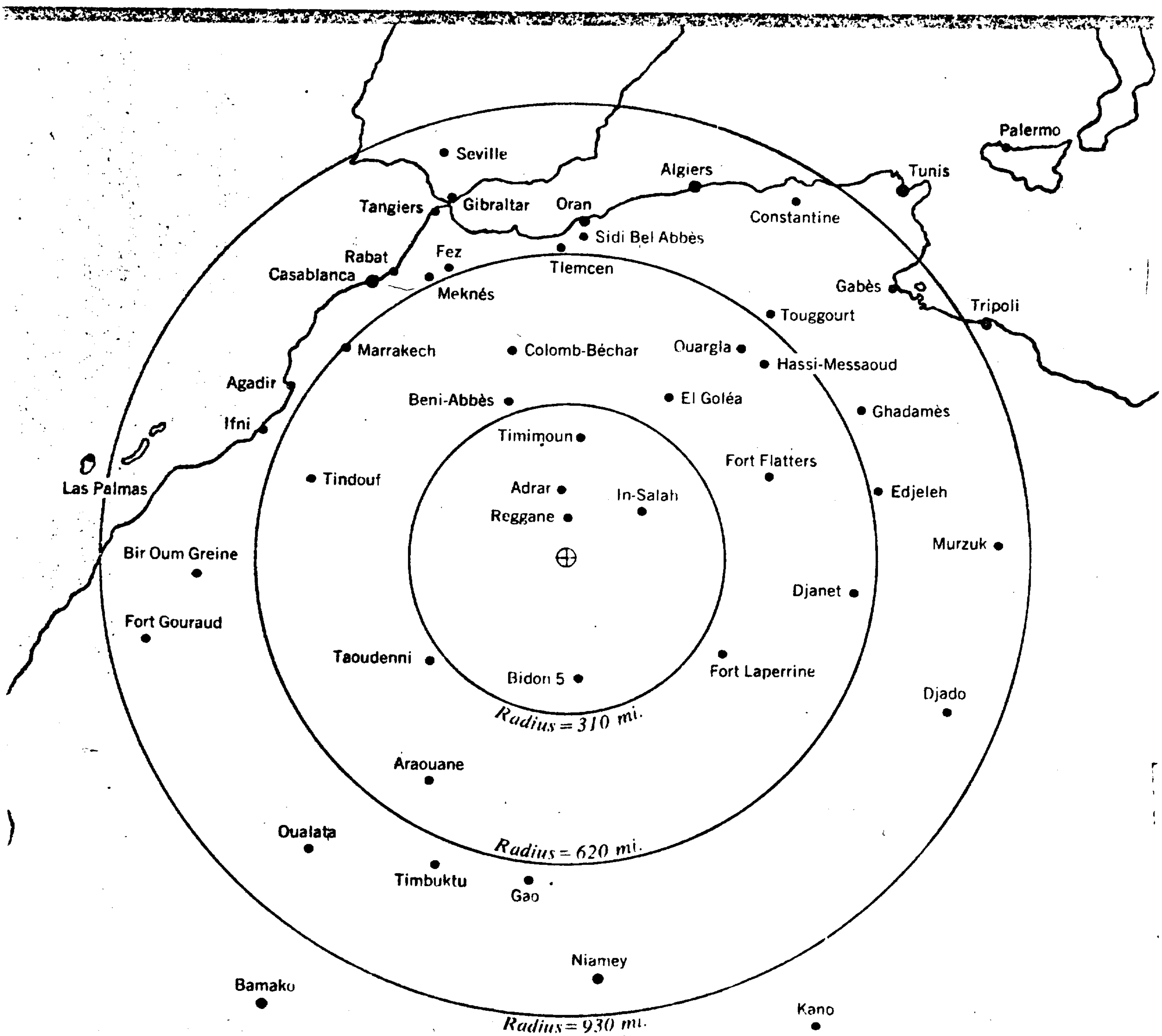
A total of 141 atmospheric nuclear explosions has been conducted in the U.S.S.R., most of them at the Semipalatinsk tests site. There are 1,216,000 people living within a radius of 310 miles of that site and 4,195,000 people within a radius of 620 miles

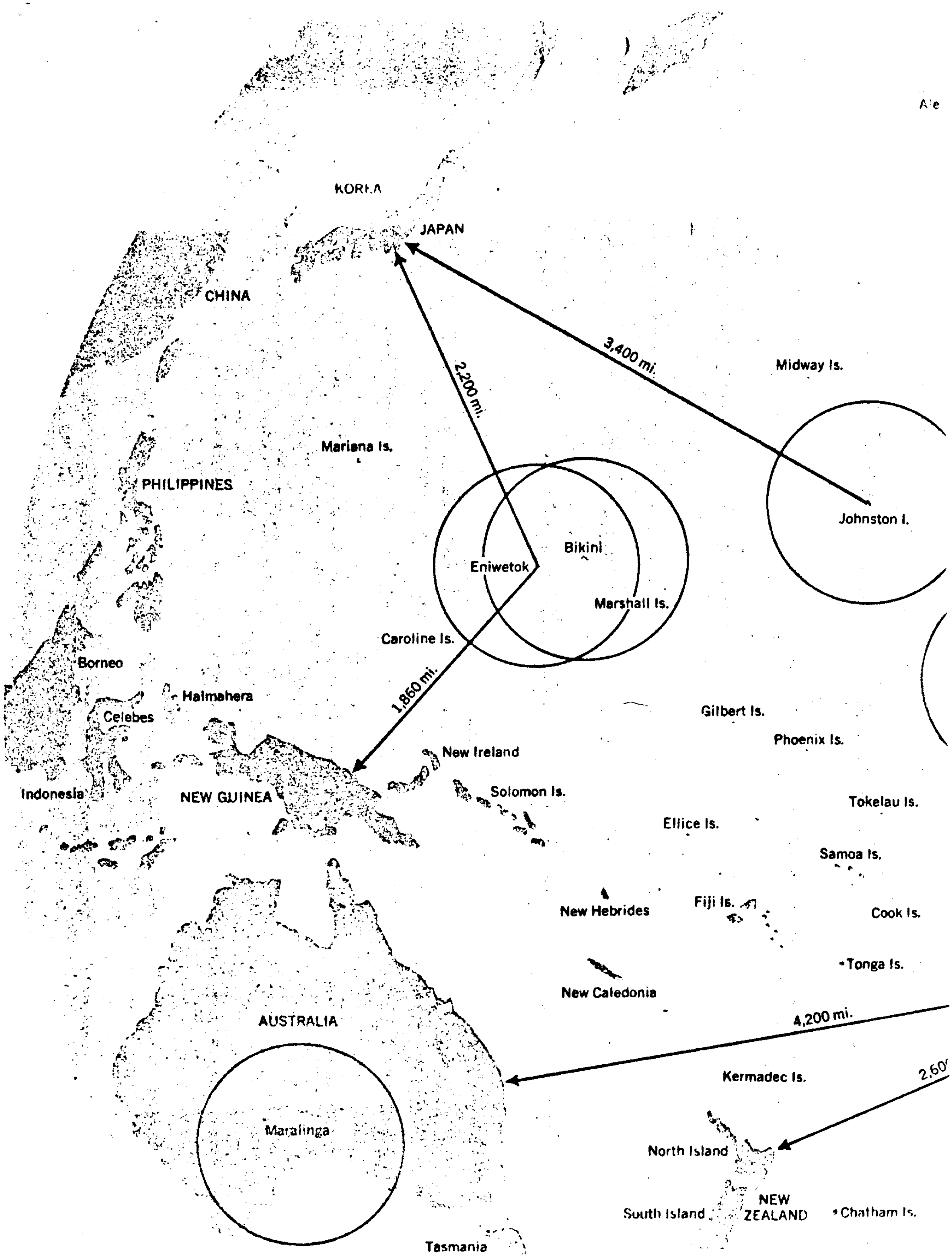


The Americans have conducted 91 atmospheric nuclear explosions at the Nevada firing grounds. That tests center is located 75 miles from the city of Las Vegas and 250 miles from the Los Angeles area, which has more than 4 million inhabitants. There are 4,885,000 people living within a radius of 310 miles of the firing zone and 7,177,000 people within a radius of 620 miles.



France's first testing grounds, at Reggane, was situated quite far from inhabited areas. Only 62,000 people lived within a radius of 310 miles of the firing points, and 385,000 people within a 620-mile radius.

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Johnston I.
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Marshall Is.
Caroline Is.
Borneo
Halmahera
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Celebes
Gilbert Is.
Phoenix Is.
New Ireland
Indonesia
NEW GUINEA
Solomon Is.
Tokelau Is.
Ellice Is.
Samoa Is.
New Hebrides
Fiji Is.
Cook Is.
Tonga Is.
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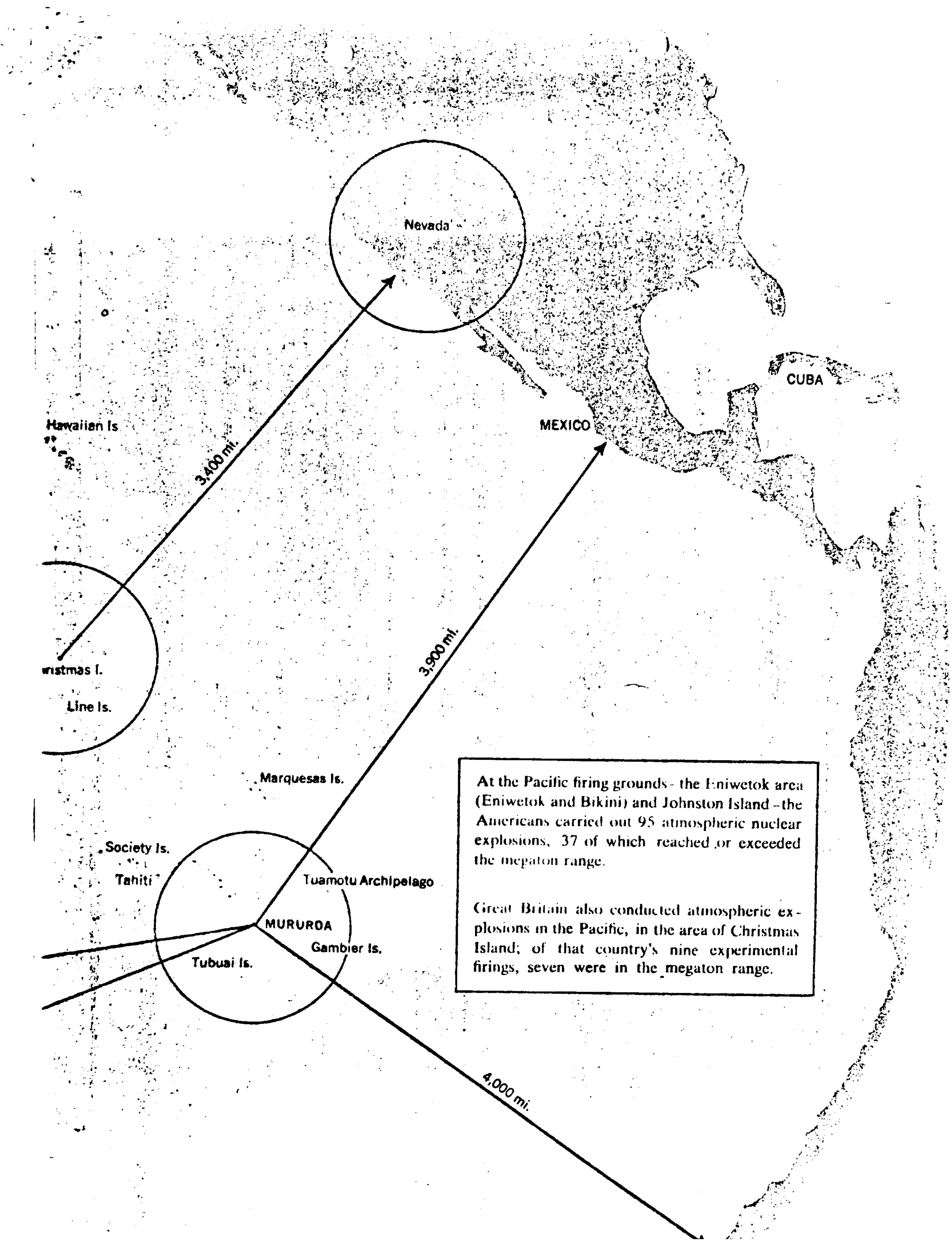


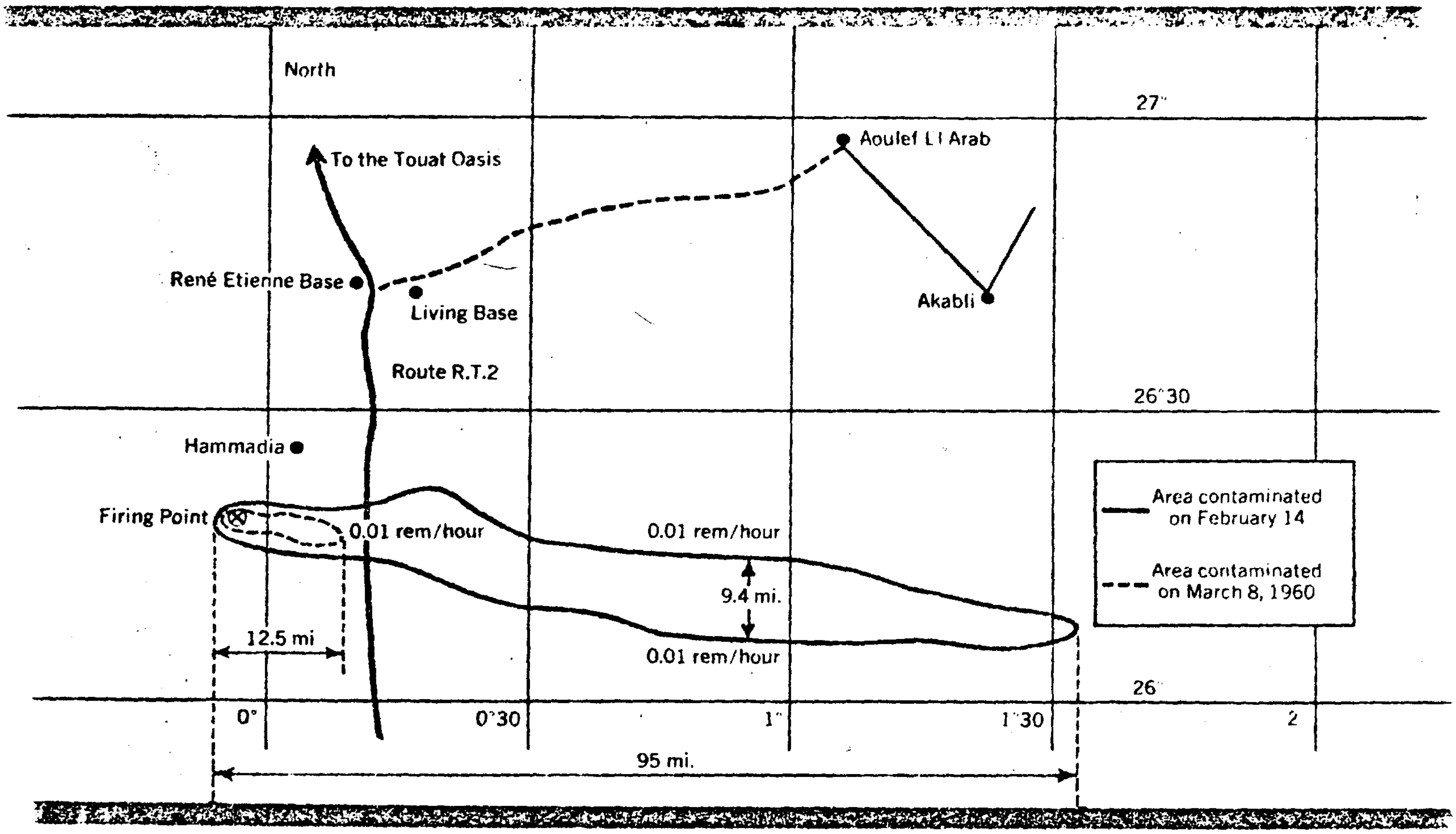
At the Pacific firing grounds - the Eniwetok area (Eniwetok and Bikini) and Johnston Island - the Americans carried out 95 atmospheric nuclear explosions, 37 of which reached or exceeded the megaton range.

Great Britain also conducted atmospheric explosions in the Pacific, in the area of Christmas Island; of that country's nine experimental firings, seven were in the megaton range.

What Precautions Can Be Taken Against Local Fallout?

The area affected by local fallout can be determined in advance on the basis of the yield of the experimental device tested, the type of firing (ground or water surface, atmospheric, underwater) and the wind system in the firing zone. The method used to delineate this area is based on observations from the French or foreign test firings.

For example, the zone contaminated by local fallout from the explosion on February 13, 1960 at Reggane affected an elliptical area 95 miles long and 9 miles wide, outside of which the radiation was under 0.01 rem/hour.* Three weeks later, the zone contaminated at the same rate of exposure, making allowance for the decrease in radioactivity, was only 12 miles long by 4 miles wide.



The firing zone at the Hammadia installations was not evacuated at the time of detonation. It was located only nine miles northeast of the firing point.

The experience gained makes it possible to assert that the risks are thoroughly known and that it is therefore easy to avoid them.

*Rem—*The rem (roentgen equivalent man) measures the amount of radiation that produces biological effects in man.*

Calculation of Radiation Safety Margins

The numerous nuclear tests conducted
have made it possible to define unanimously recognized security standards.

Atmospheric nuclear explosions, like underground nuclear explosions that are not entirely contained, actually release numerous fission products into the atmosphere that can be harmful to the human body. These products emit rays or particles which, by releasing their energy in living tissues, can cause changes in their structure or organic disturbances.

The human body fights all types of aggression against it by its spontaneous regenerative capacity. Thus it struggles against strong sudden radiation or weak continual radiation.

The many research projects carried out the world over have made it possible to evaluate quantitatively the risk resulting from radiation.

The effect of radiation depends on the length of exposure and the intensity. If strong radiation is experienced for a few hours over the entire human body:

- A dose of 25 rems causes no apparent effect.
- A dose of 75 rems marks the appearance of the first organic signs, especially changes in blood composition accompanied by fatigue and nausea.
- A dose of 200 rems marks the beginning of the acute radiation syndrome.
- A dose of 400 rems is the average lethal dose for man.

The global natural radioactivity to which man is exposed ranges from 0.2 rem/year on the average in chalky soil regions to several rems/year in especially radioactive regions of the globe, and the health of the inhabitants normally living there has never been altered.

Rays from artificial radioactivity originate mainly from medical radiation (from 0.05 to 0.02 rem/year).

World-scale fallout produced by all the nuclear tests conducted since 1945 (more than 500 experiments) stands at an average level of less than 0.01 rem/year.

The level of radioactivity due to those tests is equal to that experienced by an individual who had been living on the coast and moved for one year to an altitude of 1,500 feet. (Increase in radioactivity as a result of cosmic rays alone which rises 50% with a change of 3,000 feet in altitude.)

International radiological protection commissions are bringing together specialists from all countries. These commissions have drawn up recommendations aimed at protecting against harmful radioactivity. From their work, radiation standards have been set, the effectiveness of which has been amply demonstrated.

The radiation standards are, generally speaking, set at levels well below the threshold doses necessary before physical effects are felt, they are measured in millirems. The strict standards adopted to protect populations also apply to atomic energy workers.

However, because young people (children and adolescents) are more sensitive to radiation than adults, and pregnant women may be less resistant to radiation, the amounts of radiation adopted for the population are well below those set for atomic workers.

Although knowledge of the effects of radiation is recent,
it is possible to set universally recognized standards below which there is no risk.

In accordance with the recommendations of the international radiological protection commissions, the radiation rate from sources other than natural radioactive substances should not exceed 0.5 rem/year for the population or 5 rems/year for specialized workers.

The special commission responsible for studying security problems connected with the French nuclear tests has therefore adopted the maximum rate admissible in the area affected by these tests; this rate is 0.5 rem/year, or approximately the average rate of natural radioactivity in granite soil.

This means that an explosive nuclear test is prohibited
if there is a risk of reaching a dose of 0.5 rem in an inhabited place.

THE PRECAUTIONARY MEASURES TAKEN FOR THE TESTS IN FRENCH POLYNESIA

Among the numerous precautions taken before conducting a nuclear test, studies are obviously made of local weather conditions, particularly of the prevailing and occasional winds at different altitudes. With this information the testers can predict the radioactive cloud movement and determine the perimeter of the local fallout, outside of which no radiation above the threshold of tolerance can be produced.

Several studies had previously been made on the wind system in Polynesia, but it was still necessary to substantiate their findings and clarify certain special points on which the data was inadequate. The information needed was collected over a three-year period by a network of about 15 meteorological wind and temperature observation stations.

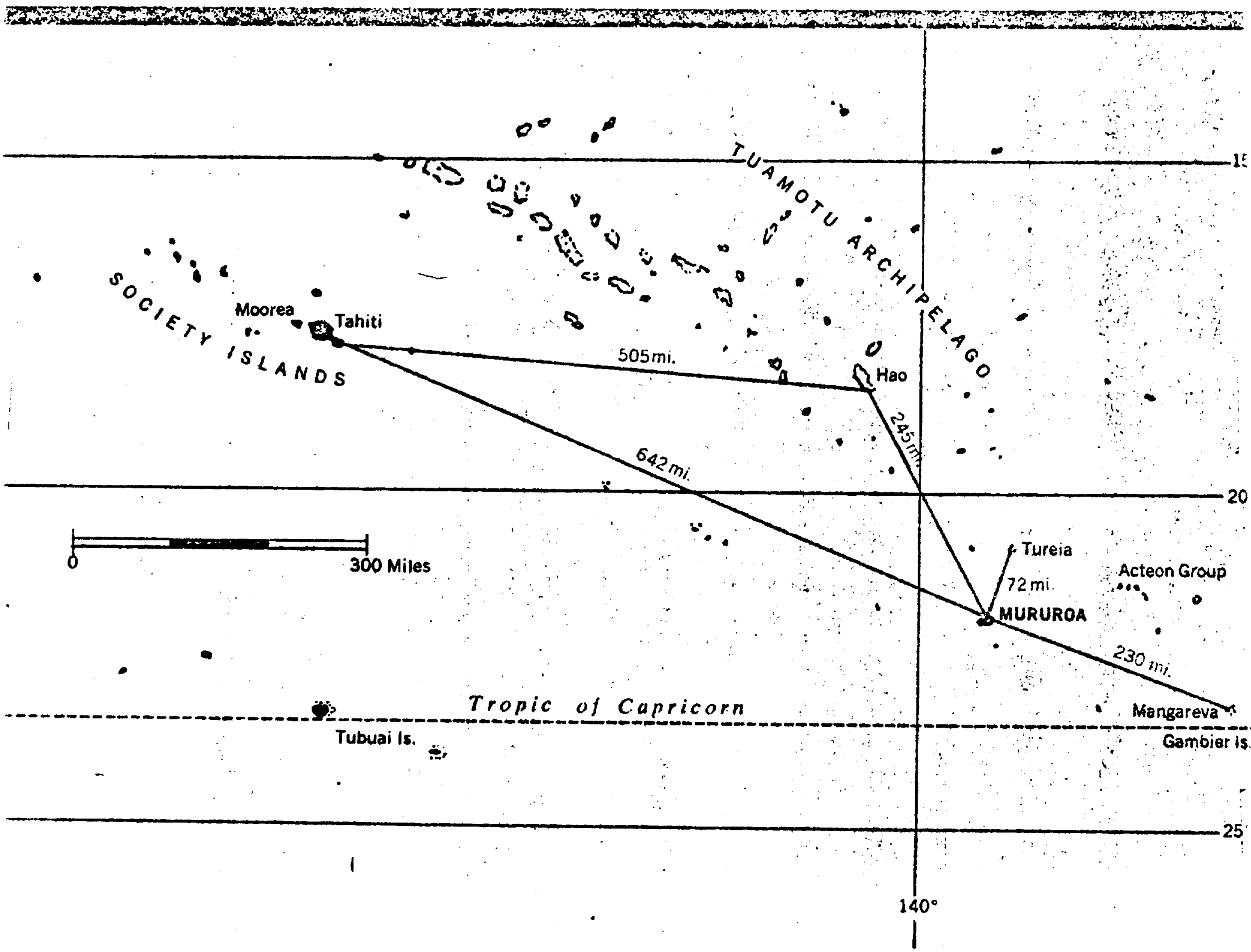
These stations' observations, combined with those of French military ships and aircraft, made it possible to gain actual experience with the weather conditions prevailing in the Southeast Pacific. It has been established that there is a stable west wind at a high altitude, and that any disturbances can be predicted for a great part of the year.

By knowing the meteorological factors, it is possible to define the zone of fallout and, taking into account the yield and altitude of the firing, to assess the amount of contamination with sufficient accuracy.

The order to fire will be given only if
the predicted fallout zone coincides with uninhabited places

The prevailing winds in and around the Pacific Tests Center will normally carry the local fallout into a sector located between the northeast and east, toward the uninhabited atolls in the Acteon group.

The Gambier Islands—Mangareva with only 400 inhabitants 265 miles east-southeast of the firing point and Turcia with 80 inhabitants 80 miles north-northeast of the firing point—are outside the predicted sector of local or distant fallout.



At the time of the nuclear tests, the testers must be responsible for the protection and surveillance of the human beings in the zones directly concerned. They must determine precisely the rise in the radioactivity level in as large a zone as possible around the point of explosion so that all precautionary measures that might prove necessary can be taken in time.

For the projected French nuclear tests in the Pacific, two technical services are in charge of French Polynesia: the Joint Radiological Security Service (SMSR) and the Joint Biological Control Service (SMCB).

The Joint Radiological Security Service (SMSR), which employs specialists from the Armed Forces and the Atomic Energy Commissariat, is responsible for two series of operations:

• Fallout location through a fixed network of 22 automatic measurement stations now spread throughout the French Polynesian atolls; at the firing time, this network will be supplemented, depending on how the fallout develops, by dropping buoys equipped with radio transmitters that will furnish precise indications on the levels of radioactivity from their drop points.

• Broader control of radioactivity through a network of 17 radiological control posts that continuously measure the radioactivity in the atmosphere, rainwater and seawater; this network will be supplemented at the firing time by detection devices onboard French merchant marine ships.

The Joint Biological Control Service (SMCB) is specifically responsible for living creatures—other than man, who comes under the control of the SMSR and the Armed Forces Health Service—and for inspecting foodstuffs and drinking water.

Among the foodstuffs inspected by this service, very special attention is given to fish. Intensive marine ecology studies have been conducted in the Polynesian area by teams from ORSTOM (Office of Overseas Scientific and Technical Research) and the French Museum of Natural History. These studies confirm the findings of similar projects carried out in France: because radioactivity is diluted considerably in seawater, it is practically impossible for the food chain of the inhabited islands to be contaminated by fish. Special supervisory measures will be taken during the firings by systematic inspection of fishing banks and examination of fish sold on local markets.

The security conditions to be set up for both the testers and the populations located in the regions outside the firing grounds have been studied and submitted for Government decision by a Consultative Committee on Site Security.

That Committee, presided over by Francis Perrin, Head of the Atomic Energy Commissariat, is formed of persons eminently well-versed in the matters at hand, such as doctors, meteorologists and atomic scientists.